

## CLAIMS:

1. A method of detecting a property of an object, the method comprising

- directing a detection laser beam to the object to produce a scattered laser beam modulated corresponding to a surface motion of said object;
- receiving the scattered laser beam with an optical interferometer to produce an interferometric transmission signal and an interferometric reflection signal corresponding to the surface motion of the object;
- generating an output signal from the interferometric transmission signal and the interferometric reflection signal, the output signal being indicative of the surface motion;

characterised in that the output signal is generated as a ratio of a signal derived from the interferometric transmission signal and a signal derived from the interferometric reflection signal.

2. A method according to claim 1, wherein the ratio of a signal derived from the interferometric transmission signal and a signal derived from the interferometric reflection signal is the ratio of the interferometric transmission signal and the interferometric reflection signal.

3. A method according to claim 1, further comprising

- generating a derived reflection signal from the interferometric reflection signal by adding a first offset to the interferometric reflection signal; and
  - generating a derived transmission signal from the interferometric transmission signal by adding a second offset to the interferometric transmission signal;
- and wherein the ratio is the ratio of the derived transmission signal and the derived reflection signal.

4. A method according to claim 3, wherein generating at least one of the derived transmission signal and the derived reflection signal comprises scaling the corresponding one of the interferometric reflection signal and the interferometric transmission signal by a respective scale factor.
5. A method according to claim 3 or 4, wherein the first and second offsets are determined such that the ratio of the derived transmission signal and the derived reflection signal at the working point of the optical interferometer is substantially constant.
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6. A method according to any one of claims 1 through 5, further comprising directing the detection laser beam to a position on the surface of the object; and moving said position relative to the surface.
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7. A method according to any one of claims 1 through 6, wherein the object is a railway track rail.
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8. A method according to any one of claims 1 through 7, further comprising inducing said motion of the object by inducing an ultrasound wave travelling in the object.
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9. A method according to claim 8, comprising directing a pulsed excitation laser beam to an excitation position on the surface of the object to induce the ultrasonic wave.
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10. A method according to any one of claims 1 through 9, wherein combining the interferometric transmission signal and the interferometric reflection signal is performed prior to any high and/or low pass filtering of the transmission signal and the reflection signal.

11. A method according to any one of claims 1 through 10, wherein the optical interferometer has a resonance frequency; and wherein the method further comprises adjusting the resonance frequency of the optical interferometer by the method defined in any one of claims 12 through 20.

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12. A method of controlling the resonance frequency of an optical interferometer, the method comprising

- receiving a laser beam with said optical interferometer to produce at least one of an interferometric transmission signal and an interferometric reflection signal; and
  - adjusting the resonance frequency of the optical interferometer in response to a control signal generated from a ratio of a first and a second signal, each being substantially proportional to the intensity of the received laser beam in a working point of the interferometer;
- 10 characterised in that the method comprises generating the control signal by
- generating a first derived signal by adding a first constant offset to the first signal;
  - generating a second derived signal by adding a second constant offset to the second signal;
  - generating the control signal as a ratio of the first and second derived signals.
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13. A method according to claim 12, wherein generating at least one of the first derived signal and the second derived signal comprises scaling the corresponding first or second signal by a respective scale factor.

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14. A method according to claim 12 or 13, wherein the first and second offsets are determined such that the ratio of the first derived signal and the second derived signal at the working point of the optical interferometer is substantially constant.

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15. A method according to any one of claims 12 through 14, wherein the resonance frequency of the optical interferometer is adjusted in response to a control signal generated from a combination of the interferometric transmission signal and the interferometric reflection signal; wherein the first derived signal is a derived reflection signal, derived from the interferometric reflection signal by adding a first offset to the interferometric reflection signal; and wherein the second derived signal is a derived transmission signal, derived from the interferometric transmission signal by adding a second offset to the interferometric transmission signal.
- 10 16. A method according to claim 15, wherein the ratio is determined prior to any high and/or low pass filtering of the transmission signal and the reflection signal.
- 15 17. A method according to any one of claims 12 through 16, further comprising directing a detection laser beam to an object to produce a scattered laser beam modulated corresponding to a motion of said object; wherein the received laser beam is the scattered laser beam; and wherein the method further comprises combining the interferometric transmission signal and the interferometric reflection signal to generate an output signal corresponding to the motion of the object and indicative of a property of the object.
- 20 18. A method according to claim 17, wherein the combining comprises
- 25     – scaling at least one of the interferometric reflection signal and the interferometric transmission signal relative to the corresponding other signal by a predetermined relative scale factor; and
- 30     – combining the scaled interferometric reflection and transmission signals with one another to obtain the output signal.

19. A method according to claim 18, wherein combining the scaled interferometric reflection and transmission signals with one another comprises subtracting the scaled interferometric reflection and transmission signals from another.

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20. A method according to claim 18 or 19, wherein the scale factor is a predetermined constant scale factor.

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21. A method according to claim 18 or 19, further comprising

- detecting a noise level of the output signal; and
- adaptively controlling the scale factor to reduce the detected noise level.

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22. A detection device for detecting a property of an object, the device comprising

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- a detection laser arrangement adapted to direct a detection laser beam to the object to produce a scattered laser beam modulated corresponding to a motion of said object;
- an optical interferometer adapted to receive the scattered laser beam and to produce an interferometric transmission signal and an interferometric reflection signal corresponding to the motion of the object;
- signal processing means adapted to generate an output signal from the interferometric transmission signal and the interferometric reflection signal, the output signal being indicative of the property to be detected;

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characterised in that the signal processing means is adapted to generate the output signal a ratio of a signal derived from the interferometric transmission signal and a signal derived from the interferometric reflection signal.

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23. A detection device according to claim 22, wherein the optical interferometer has a resonance frequency; and wherein the detection device further comprises control means for adjusting the resonance frequency of the optical interferometer in response to a control signal generated from a combination of the interferometric transmission signal and the interferometric reflection signal.
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24. A detection device according to claim 22 or 23, wherein the detection laser is a continuous-wave laser.
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25. A detection device according to any one of claims 22 through 24, wherein the ratio of a signal derived from the interferometric transmission signal and a signal derived from the interferometric reflection signal is the ratio of the interferometric transmission signal and the interferometric reflection signal.
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26. A detection device according to any one of claims 22 through 25, further comprising
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- an adder circuit for generating a derived reflection signal from the interferometric reflection signal by adding a first offset to the interferometric reflection signal; and
  - an adder circuit for generating a derived transmission signal from the interferometric transmission signal by adding a second offset to the interferometric transmission signal;
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- and wherein the ratio is the ratio of the derived transmission signal and the derived reflection signal.
27. A detection device according to claim 26, further comprising means for scaling one of the interferometric reflection signal and the interferometric transmission signal by a respective scale factor.
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28. A detection device according to claim 26 or 27, wherein the first and second offsets are determined such that the ratio of the derived transmission signal and the derived reflection signal at the working point of the optical interferometer is substantially constant.

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29. A detection device according to any one of claims 22 through 28, wherein the optical interferometer has a resonance frequency; and wherein the detection device further comprises means for adjusting the resonance frequency of the optical interferometer.

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30. An optical interferometer adapted to receive a laser beam and to produce at least one of an interferometric transmission signal and an interferometric reflection signal; wherein the optical interferometer comprises control means adapted to adjust the resonance frequency of the optical interferometer in response to a control signal;

characterised in that the optical interferometer further comprises signal processing means adapted to generate the control signal from a ratio of a first and a second signal, each being substantially proportional to the intensity of the received laser beam in a working point of the interferometer,

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by

- generating a first derived signal by adding a first offset to the first signal;
- generating a second derived signal by adding a second offset to the second signal; and
- generating the control signal as a ratio of the first derived signal and the second derived signal.

31. An optical interferometer according to claim 30, further comprising means for scaling one of the first and second signals by a respective scale factor.

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32. An optical interferometer according to claim 30 or 31, wherein the first and second offsets are determined such that the ratio of the first derived signal and the second derived signal at the working point of the optical interferometer is substantially constant.